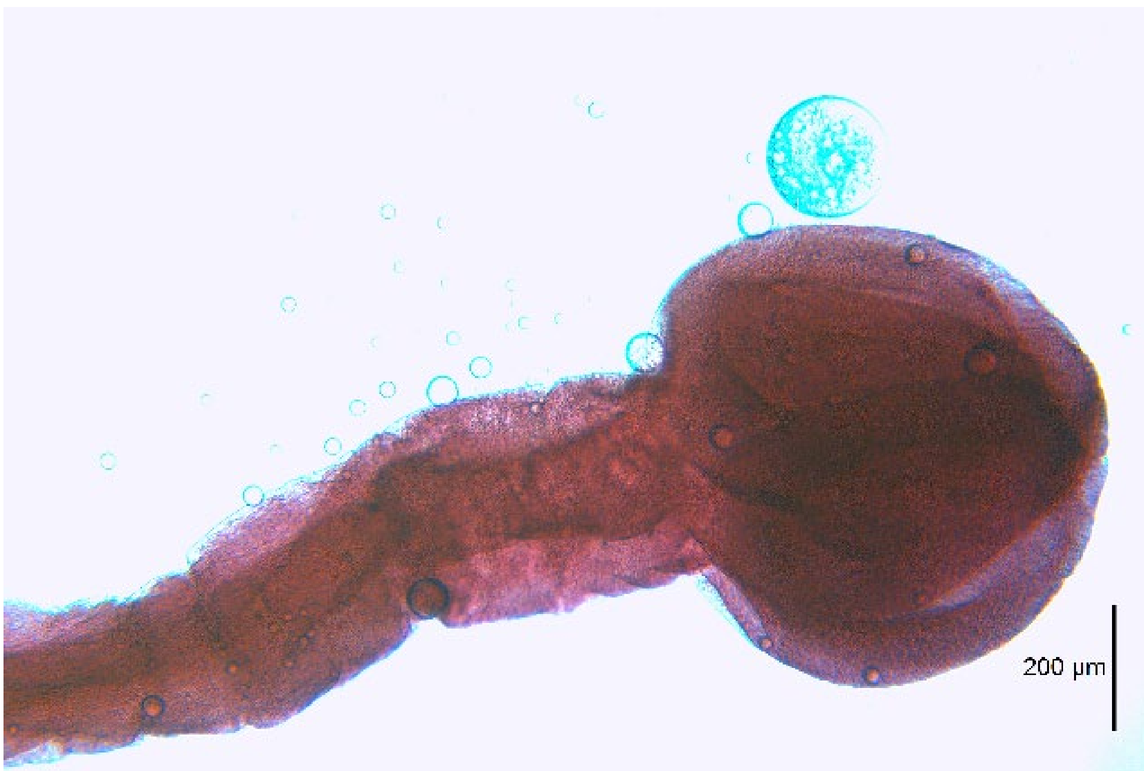
U.S. Fish & Wildlife Service

Asian Tapeworm (*Schyzocotyle acheilognathi*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2024
Revised, February 2024
Web Version, 2/6/2026

Organism Type: Flatworm
Overall Risk Assessment Category: High



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1 Native Range and Status in the United States

Native Range

From Hejna et al. (2024):

"Native to East Asia and China, *Schyzocotyle acheilognathi* was first described by S. Yamaguti in 1934 from Ogura Lake, Japan (Scholz, 1997)."

Ahmad et al. (2018) report *S. acheilognathi* (as *Bothriocephalus acheilognathi*) as native to China (Chongqing, Fujian, Gansu, Guangdong, Guizhou, Heilongjiang, Hubei, Jiangxi, Jilin, Liaoning, Nei Menggu [Inner Mongolia], Ningxia, Shanxi, Sichuan provinces), Mongolia, and Russia (Eastern Siberia and the Russian Far East).

Status in the United States

From Hejna et al. (2024):

"This parasite has become widespread, and is known in several areas of the United States. It appears to be well established in the lower Colorado River and the Hawaiian islands (Choudhury et al., 2006), and has been reported in the Great Lakes (Marcogliese, 2008) and Susquehanna River watershed (Reyda et al. 2019)."

Hejna et al. (2026) report *Schyzocotyle acheilognathi* as established in Arizona, California, Hawaii, Nevada, New Mexico, New York, North Carolina, Texas, and Utah. They also report *Schyzocotyle acheilognathi* as collected in Colorado and Michigan, and introduced with unknown status in Illinois and Wisconsin.

From Bunkley-Williams and Williams (1994):

"Records in Puerto Rico - Present in 2 of 6 guppies at the Maricao Hatchery, 3 of 4 guppies in the Maricao River and 6 of 8 guppies in a small stream west of Lajas. In Maricao, only one adult worm occurred in each fish, but in Lajas 1-3 were found. […] now established [in Puerto Rico] and independent of its original host."

No records of *Schyzocotyle acheilognathi* directly in trade in the United States were found. However, *S. acheilognathi* has been found parasitizing fish in trade in the United States. For example:

From Boonthai et al. (2017):

"We collected live baitfish for examination from 78 retail stores in Michigan between September 2015 and June 2016."

"*Schyzocotyle acheilognathi* was regularly detected in baitfish collected from bait shops throughout Michigan […]. Specifically, 48 of 90 (53.3%) lots examined resulted in the presence of *S. acheilognathi* […]."

Regulations

Schyzocotyle acheilognathi is regulated as a fish parasite in Oregon (Oregon Secretary of State 2023) and Utah (Utah Office of Administrative Rules 2023). Please refer back to state agency regulatory documents for details on the regulations, including restrictions on activities involving this species. While effort was made to find all applicable regulations, this list may not be comprehensive. Notably, it does not include regulations that do not explicitly name this species or its genus or family, for example, when omitted from a list of authorized species with blanket regulation for all unnamed species.

Means of Introductions within the United States

From Hejna et al. (2024):

"*Schyzocotyle acheilognathi* was first identified in North America in 1975 in Golden Shiner (*Notemigonous crysoleucas*) and Fathead Minnow (*Pimephales promelas*) (Kuchta et al. 2018). It is likely to have been accidentally introduced into North America as early as 1963 with Grass Carp (*Ctenopharyngodon idella*), one of its native hosts, and subsequently spread through the translocation of bait fish (Choudhury et al. 2006; Heckmann et al. 1993; Kuchta et al. 2018). For example, Heckmann et al. (1993) found infected minnows in four bait shops near Las Vegas, NV, that had originated from commercial ponds outside the state and Boonthai et al. (2017) found *S. acheilognathi* to be widespread in baitfish in Michigan."

From Boonthai et al. (2017):

"Our findings indicate that the end of the trade custody chain (i.e. baitfish retail shops) represents a source for the potential introduction of *S. acheilognathi* via angler-purchased and potentially released baitfish."

From Cole and Choudhury (2015):

"Another suitable host, the mosquitofish *Gambusia*, is commonly used to control mosquitoes and stocking of this fish probably introduced the tapeworm to California (Hoffman, 1999; Warburton et al., 2002; Choudhury et al., 2006; Heckmann, 2009). The movement of infected baitfish resulted in the parasite's successful colonization of the U.S. Southwest (Heckmann et al., 1993; Choudhury et al., 2004)."

From Bunkley-Williams and Williams (1994):

"This worm probably was introduced in grass carp brought into Puerto Rico on numerous occasions since 1972 […]"

Remarks

No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2024):

Kingdom Animalia
  Subkingdom Bilateria
    Infrakingdom Protostomia

Superphylum Spiralia
Phylum Platyhelminthes
Subphylum Rhabditophora
Infraphylum Trepaxonemata
Superclass Euneoophora
Class Acentrosomata
Subclass Bothrioneodermata
Infraclass Neodermata
Order Bothriocephalidea
Family Bothriocephalidae
Genus *Schyzocotyle*
Species *Schyzocotyle acheilognathi* (Yamaguti, 1934)

According to WoRMS (2023), *Schyzocotyle acheilognathi* is the current valid name for this species.

The following synonym of *Schyzocotyle acheilognathi* from WoRMS (2023) was used to search for information for this report: *Bothriocephalus acheilognathi*.

Size, Weight, and Age Range

From Cole and Choudhury (2015):

"The worm's length is variable depending on the host, the ecological setting and age of the host, the age of infection and the number of worms; 3.5-8 cm is typical, although specimens up to 1 m in length have been reported."

Environment

From Hejna et al. (2024):

"Eggs require water temperatures between 12ºC and 37ºC to hatch. Within this range, the amount of time required for hatching varies with water temperature. Eggs tend to hatch within 1-5 days at 28-30ºC, and within 10-28 days at 14-15ºC (Marcogliese, 2008)."

"[…] larvae become able to infect their final host in 11-18 days at 29-31ºC, and in 49 days at 20ºC (Marcogliese, 2008)."

Climate

From Ahmad et al. (2018):

"[…] it is able to colonize a wide range of fish and copepod hosts, over a broad latitudinal range, […]."

Distribution Outside the United States

Native

From Hejna et al. (2024):

"Native to East Asia and China, *Schyzocotyle acheilognathi* was first described by S. Yamaguti in 1934 from Ogura Lake, Japan (Scholz, 1997)."

Ahmad et al. (2018) report *S. acheilognathi* (as *Bothriocephalus acheilognathi*) as native to China (Chongqing, Fujian, Gansu, Guangdong, Guizhou, Heilongjiang, Hubei, Jiangxi, Jilin, Liaoning, Nei Menggu [Inner Mongolia], Ningxia, Shanxi, Sichuan provinces), Mongolia, and Russia (Eastern Siberia and the Russian Far East).

Introduced

From Cole and Choudhury (2015):

"In Mexico, it appears to be widely distributed (Salgado-Maldonado and Pineda-López, 2003; Rojas-Sánchez and García-Prieto, 2008). In Australia, it is established in the eastern part of the continent (Dove and Fletcher, 2000). In Europe, it is absent from northern European (Scandinavian) countries; the current status in many central and eastern European countries seems unclear. In South Africa, it is common in carp in certain areas and remains well established."

"Beginning in the 1950s, it was detected in western parts of the former Soviet Union, […] By the late 1950s and early 1960s, it was known from Ukraine and the Moscow area (Bykhovskaya-Pavlovskaya et al. 1962) as well as from Romania (Radulescu and Georgescu, 1962). In the early 1970s, it spread across eastern and western Europe (Scholz et al., 2012). A steady stream of reports indicated its worldwide presence, for example in Sri Lanka (Fernando and Furtado, 1963), Malaysia (Fernando and Furtado, 1964), Uzbekistan (Osmanov, 1971), Hungary (Molnar and Murai, 1973), Croatia (Kezic et al., 1975, cited in Hoffman, 1999), Germany (Korting, 1974), […] the former Czechoslovakia (Faina and Par, 1977), Afghanistan (Moravec and Amin, 1978), England (Andrews et al., 1981), South Africa (Boomker et al, 1980; Brandt et al., 1981; Van As et al., 1981; Van As and Basson, 1984), Mexico (López-Jiménez, 1981), Philippines (Velasquez, 1982; Arthur and Lumanlan-Mayo, 1997), […] France (Denis et al., 1983), Italy (Minervini et al., 1985; Scholz and Cave, 1992), Iraq (Khalifa,1986), Korea (Kim et al., 1986, cited in Paperna, 1996), […] Brazil (Rego et al., 1999), Australia (Dove et al., 1997; Dove and Fletcher, 2000), Turkey (Aydogdu et al., 2003), Canada (Choudhury et al., 2006), Panama (Choudhury et al., 2013), and most recently Honduras (Salgado-Maldonado et al., 2015)."

"As well as its apparently low host specificity, its simple two-host life cycle using copepods (Hanzelová and Žitnan, 1986; Marcogliese and Esch, [1989]) as the intermediate host with fish as the definitive host have underpinned its great success in invading every continent except Antarctica (Bauer and Hoffman, 1976; Dove and Fletcher, 2000)."

From Choudhury et al. (2006):

"A single immature specimen of the parasite was collected from a white bass, *Morone chrysops* (Rafinesque) in Lake Winnipeg, Manitoba, Canada. […] The previous record of *B. acheilognathi* in Canada, from the northern pikeminnow, *Ptychocheilus oregonensis* in British Columbia, is a misidentification of *Eubothrium tulipai*."

From Sheikh et al. (2014):

"Seasonal surveys were conducted at the Dal Lake of Srinagar [Jammu and Kashmir, India] between April 2013 and January 2014. Twenty *Schizothorax niger* and 20 *Cyprinus carpio* were collected with the aid of gill nets. […] The majority (99.8%) of the cestodes found in both fish species were identified as *B. acheilognathi* [*S. acheilognathi*] (Asian tapeworm)."

From İnnal et al. (2016):

"This study reports here on the current status of the Asian fish tapeworm, *S. acheilognathi* in the freshwater of Turkey. It was recorded to date in 26 fish species from 7 families [in Turkey]."

From De Souza et al. (2018):

"In South America, *Schyzocotyle* was reported in *Cyprinus carpio* from a Brazilian fish farm at the municipality of Cornélio Procópio, northern Paraná State and from the natural environment in *C. carpio* from Neuquen River, Patagonia, Argentina. […] Herein we report the first occurrence of the invasive tapeworm *S. acheilognathi* in *Rineloricaria pentamaculata* (Siluriformes, Loricariidae), a native armored freshwater catfish from southern Brazil."

"Fifteen specimens of *R. pentamaculata* were collected, and only a single specimen presented one cestode parasitizing the small intestine."

From Scholz et al. (2018):

"In April 2016, freshwater fishes of six species from Antsohihy (Anjingo River), Madagascar (14°53' S, 47°54' E) were examined for the presence of metazoan parasites. Among them, originally unidentified species of the endemic cichlid genus *Ptychochromis* Steindachner, 1880, designated as *Ptychochromis* sp. 1 […] was infected with 43 specimens of *S. acheilognathi* (prevalence 40 %; intensity of infection 1 – 18; mean intensity ± SD 7.5 ± 8.2; mean abundance ± SD 3.0 ± 6.2). […] Most tapeworms were not fully developed and only a few specimens contained gravid proglottids with the eggs in the uterus."

Additionally, according to Ahmad et al. (2018), *S. acheilognathi* has been introduced and is invasive in Germany, Iran, Iraq, Italy, Kazakhstan, and Russia (Central, South, and western Siberia); introduced with no further information on establishment status in Afghanistan, Azerbaijan, Canada, Georgia, Honduras, Israel, Korea, Kyrgyzstan, Malaysia, Mauritius, Nigeria, Panama, the Philippines, Sri Lanka, Tajikistan, Turkmenistan, and Uzbekistan;

introduced with localized distribution in Algeria and Argentina; and introduced but absent from New Zealand.

Means of Introduction Outside the United States

From Cole and Choudhury (2015):

"Beginning in the 1950s, [*Schyzocotyle acheilognathi*] was detected in western parts of the former Soviet Union, largely because infected carp were moved to and between fish farms."

"*B. acheilognathi* is mainly spread by the introduction of infected fish hosts such as the common carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodon idella*), often for aquaculture (Bauer et al., 1969; Minervini et al., 1985; Fuller et al., 1999; Bauer and Hoffman, 1976). One of the major hosts, *C. idella*, has been widely used for controlling aquatic weeds and this has resulted in the tapeworm invading places such as North America and Panama (Hoffman, 1999; Choudhury et al., 2013; López-Jiménez, 1981; Maitland and Campbell, 1992; Fuller et al., 1999)."

Short Description

From Scholz (1997):

"Worms moderately large; strobila consisting of rather elongate proglottides (proglottis length/width ratio usually 1:0.5-3). Scolex heart-shaped or almost spherical; terminal disc feebly developed, narrow; dorsally and ventrally situated bothria short and verydeep, with small openings. Neck absent; first proglottides immediately posterior to scolex, much narrower than scolex […]."

"Testes medullary, spherical to oval. Cirrus-sac muscular, spherical, anterior to ovary. Male genital pore dorsal, opening into common genital atrium. Ovary bi-lobed, median, near posterior margin of proglottis. Vagina tubular, slightly sinuous, opening into common genital atrium posterior to male genital pore. Vitelline follicles cortical, spherical to oval, forming 2 lateral bands confluent between proglottides; band connected medially by several follicles, mostly in ovarian region […]. Uterus tubular, sinuous, forming spherical or oval uterine sac opening ventrally near anterior part of proglottis. Eggs operculate, unembryonated."

Biology

From Hejna et al. (2024):

"*Schyzocotyle acheilognathi* has a less complex life cycle than many tapeworm species, requiring only one intermediate host before reaching its final host (Hansen et. al, 2007). The adult worm is an intestinal parasite in fish. It absorbs nutrients directly across the tegument (body covering), competing with the host animal for nutrition (Hansen et al. 2006)."

"Adult worms are hermaphroditic; each proglottid has a complete set of both male and female reproductive organs and produces eggs through self-fertilization. The eggs are shed into the water with the host's fecal material, where they hatch into free-swimming hexacanth (six-hooked) larvae."

"In a review of 651 studies, Kuchta et al. (2018) found that *S. acheilognathi* can infect 312 fish species from 38 families and 14 orders, with species from the family Cyprinidae being the most commonly infected. Futhermore, the same study found that 11 non-fish species (5 amphibians, 1 reptile, 4 birds, and 1 mammal [humans]) can be infected although these non-fish are not thought to be definitive hosts. However, non-fish hosts, particularly aquatic birds, may be able to act as vectors transporting this parasite among water bodies (Kuchta et al. 2018)."

From Marcogliese (2008):

"The Asian fish tapeworm is considered primarily a parasite of cyprinids (Liao and Shih 1956, Choudhury et al. 2006)."

"One reason for the parasite's tremendous success and extensive geographic range expansion is that it does not appear to be specific for its intermediate host, being capable of infecting numerous species of cyclopoid copepod (Marcogliese and Esch 1989). Moreover, in addition to being able to infect a variety of cyprinid fishes, it has been found in ictalurids, salmonids, centrarchids, poecilids, and killifish (Granath and Esch 1983; Choudhury et al. 2004, 2006). Its principle host is common carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodon idellus*) (Liao and Shih 1956, Dove and Fletcher 2000) […]"

Human Uses
No information was found on human uses of *Schyzocotyle acheilognathi*.

Diseases
No information was found on diseases associated with *Schyzocotyle acheilognathi*.

Threat to Humans
From Yera et al. (2013):

"We report the first case of egg isolation of the Asian fish tapeworm *Bothriocephalus acheilognathi* (Bothriocephalidea) from human stool. A male patient from Saint Laurent du Maroni (French Guiana) presenting abdominal pain was examined in France for the diagnosis of intestinal parasites. *Diphyllobothrium*-like eggs were observed in his stool. However, molecular phylogenetic analyses based on sequences of rDNA and COI genes showed that the eggs observed belong to a bothriocephalidean cestode *B. acheilognathi*. The adult life stages of *B. acheilognathi* cestodes are known as invasive parasites of a wide spectrum of fish; however, they have not been described to parasitize any mammals. This human infection seems to be accidental and represents a parasite passage through human intestine after the consumption of an infected fish host."

From Cole and Choudhury (2015):

"Moderate to heavy *B. acheilognathi* infections can be fatal to fish fingerlings. This has been documented in cultured grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*) and koi (Yeh, 1955; Bauer et al. 1969; Han et al., 2010); Liao and Shih (1956) reported severe losses in grass carp of the young-of-the-year age class in China, with a mortality rate of 90% in winter months (Liao and Shih, 1956). Costs to aquaculture, beyond loss of fish, are due to disruption of normal hatchery and fish farming operations, increased cost of operation as a result of treating fish (with medication administered in diet), and draining and disinfecting tanks and ponds. Aquaculture operations have to invest in additional quarantine and inspection infrastructure and personnel."

3 Impacts of Introductions

From Cole and Choudhury (2015):

"The impact of *B. acheilognathi* on biodiversity is still largely unknown, and assessing the population-level impact is difficult, but it is suspected of impacting populations of two IUCN-listed endangered North American fish species, the woundfin (*Plagopterus argentissimus*) and the humpback chub (*Gila cypha*), and potentially threatens others such as the U.S. federally listed endangered Tui Mohave chub *Siphateles bicolor mohavensis* (Heckmann, 2000, 2009; Hoffnagle et al., 2006; Choudhury and Cole, 2012; Archdeacon et al., 2008; Stone et al., 2007). Also in the USA, it hinders growth of the Near Threatened roundtail chub *Gila robusta* (Brouder, 1999) and the US-listed Topeka shiner *Notropis topeka* (Koehle and Adelman, 2007); experimental infections in the Critically Endangered bonytail chub (*Gila elegans*) resulted in reduced growth, decline in health condition indices, and accelerated mortality when food was reduced (Hansen et al., 2006)."

From Hejna et al. (2024):

"Infection with *Schyzocotyle acheilognathi acheilognathi* has been shown to reduce a fish's ability to cope with stressors such as reduced food availability (Hansen, et al., 2006). Competing with intestinal parasites for nutrients may lead to reduced body condition, anemia, reduced growth and temperature-dependent mortality, especially in juvenile fish. Other known pathogenic effects include intestinal inflammation, protein depletion and altered digestive enzyme activity (Marcogliese, 2008). Infected baitfish in Michigan exhibited symptoms including enlargement of the abdomen, intestinal distension, and intestinal occlusion and hemorrhage ([Boonthai] et al. 2017)."

From Brouder (1999):

"The Asian fish tapeworm *Bothriocephalus acheilognathi* has parasitized many native fish species, but little is known of its effects on native cyprinid fish hosts. I found a strong negative correlation (Spearman's rank correlation, $r_s = -0.846$; $P < 0.001$) between total length of roundtail chub *Gila robusta* and number of Asian fish tapeworms. A significant, but weaker negative correlation existed between weight of fish and number of tapeworms ($r_s = -0.687$; $P < 0.001$). In addition, infected fish were significantly shorter ($P = 0.0241$) than uninfected fish. Infection by Asian fish tapeworm may slow growth, increase susceptibility to infestation, and increase predation on roundtail chub and possibly other native cyprinids."

"A strong negative association between total length and infection intensity, along with a significant difference in total length of infected versus uninfected fish, indicates that tapeworm infection may have slowed growth of fish. It is not clear whether these results indicate a cause and effect relationship (i.e., tapeworms caused slower growth). However, results are probably not due solely to natural variability in growth, genetic predisposition of hosts, or variability in parasites but may be a combination of at least two of the three."

"Infection intensity may be higher in small fish as a result of differential diet among size of fish. In systems where *B. acheilognathi* is present, small fish are more likely to feed upon cyclopoid copepods than large fish (Vanicek and Kramer 1969; Minckley 1973; Sublette et al. 1990) and may be more susceptible than larger fish to infection by the tapeworm. Once infected, growth may slow and increase the likelihood of continued consumption of copepods and, therefore, increase infection."

The following source discusses the negative impacts of *Schyzocotyle acheilognathi* infection on the endangered minnow *Notropis topeka* (Topeka shiner) in a laboratory experiment:

From Koehle and Adelman (2007):

"We examined the effects of Asian tapeworm on Topeka shiners to better understand the results of our experiments and to determine how Topeka shiners respond to a parasite infection."

"The presence of tapeworms reduced fish growth rate […] and survival. A reduction in growth, though not always quantified, has been reported for several other fish species parasitized by tapeworms (Brouder 1999; Pulkkinen and Valtonen 1999; Sirois and Dodson 2000; Saksvik et al. 2001). Although mortality due to low levels of tapeworm infection is not often a major concern, this study demonstrated reduced growth and increased mortality with heavy tapeworm infection, so care should be taken to check fish for Asian tapeworm infection before rehabilitation stocking is implemented."

Schyzocotyle acheilognathi is regulated as a fish parasite in Oregon (Oregon Secretary of State 2023) and Utah (Utah Office of Administrative Rules 2023). See section 1.

4 History of Invasiveness

The History of Invasiveness for *Schyzocotyle acheilognathi* is classified as High. This species is widely distributed globally outside of its native range. It is present in fish in trade, and at least two states (Utah and Oregon) have regulations requiring that fish involved in commerce in that state be certified free of infection with this parasite. Negative impacts of introduction of *S. acheilognathi* have been well-documented in scientific literature. For example, it is associated with mortality of the endangered Topeka Shiner (*Notropis topeka*) in a laboratory setting, and its presence in Roundtail Chub (*Gila robusta*) is correlated with lower fish length and weight. Infections with this parasite can also lead to increased costs to aquaculture through loss of fish and need for treatment and disinfection.

5 Global Distribution

Figure 1. Reported global distribution of *Schyzocotyle acheilognathi*. Map from GBIF Secretariat (2024). Observations are reported from continental North America, Puerto Rico, Hawaii, Australia, Japan, Hungary, Ethiopia, Rwanda, and South Africa. The points in Hungary, Ethiopia, Rwanda, and South Africa shown on this map represent country centroids rather than specific locations where *S. acheilognathi* was detected, so they were not used to select source points for the climate matching analysis. The points in Manitoba and British Columbia are not known to represent established populations (Choudhury et al. 2006), so they were not used to select source points for the climate matching analysis. Points in the United States that did not represent established populations were also omitted from the climate matching analysis (see section 6).

Additional georeferenced locations for *S. acheilognathi* used for the climate matching analysis (section 7) included locations from Sheikh et al. (2014; India), Xi et al. (2016; China), İnnal et al. (2016; Turkey), Marcogliese et al. (2016; Canada), Smit et al. (2017; South Africa), and Scholz et al. (2018; Madagascar).

No georeferenced occurrence data were available for portions of the established range of *S. acheilognathi*, including Russia, Mongolia, Germany, Iran, Iraq, Italy, and Kazakhstan.

6 Distribution Within the United States

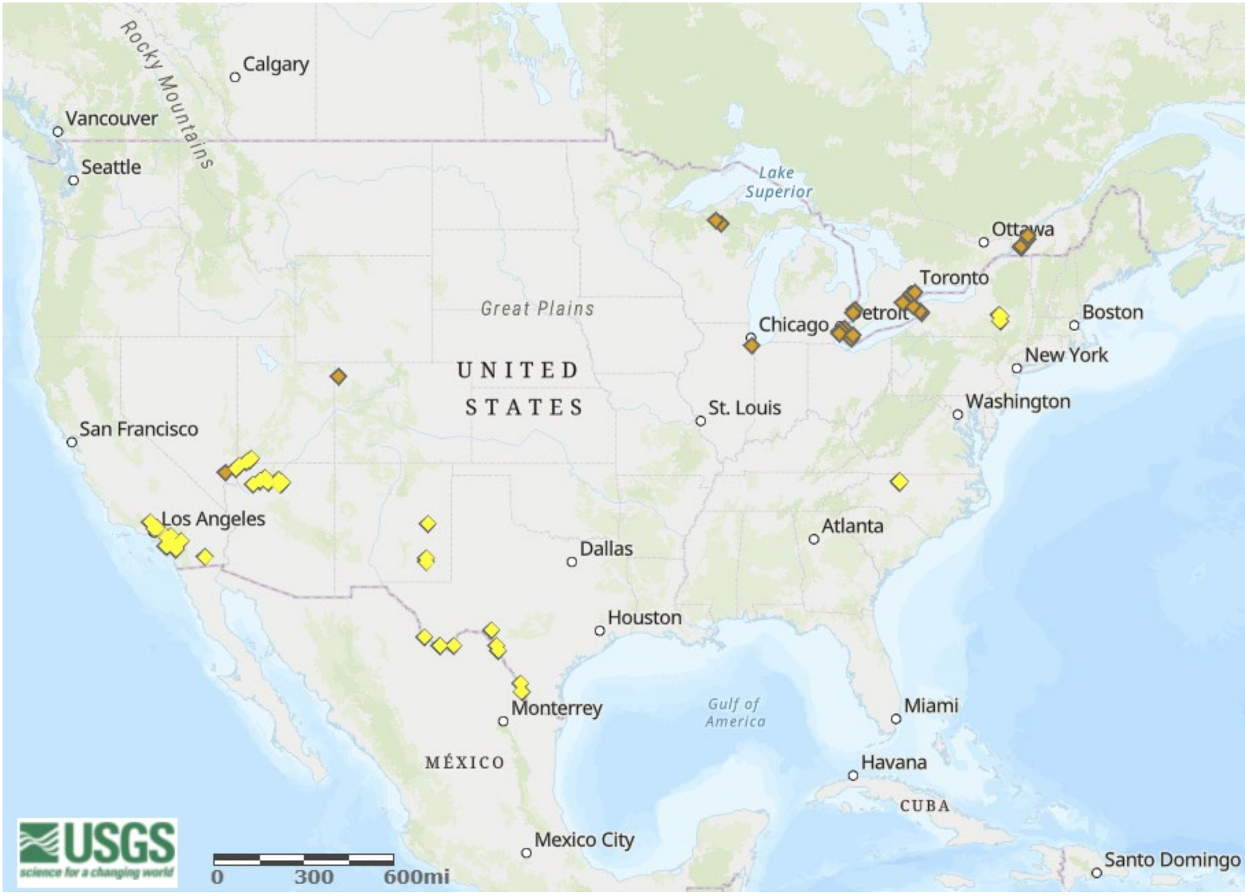

Figure 2. Reported distribution of *Schyzocotyle acheilognathi* in the contiguous United States. Map from Hejna et al. (2026). Observations are reported from Arizona, California, Colorado, Illinois, Michigan, Nevada, New Mexico, New York, North Carolina, Texas, Utah, and Wisconsin. Yellow points represent established nonnative populations and orange points represent other reported nonnative occurrences of *S. acheilognathi*. Only established populations were used to select source locations for the climate matching analysis.

Figure 3. Reported distribution of *Schyzocotyle acheilognathi* in Hawaii. Map from Hejna et al. (2026).

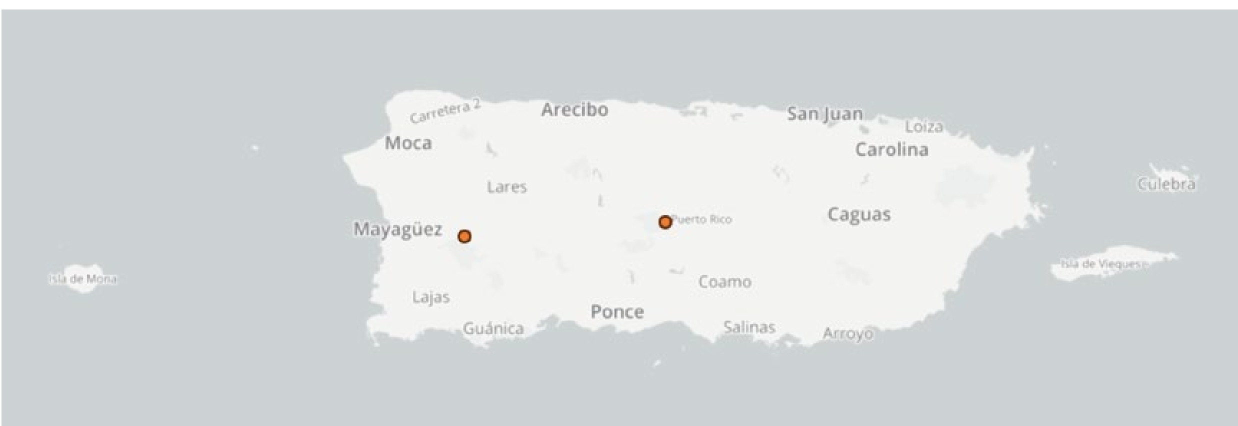

Figure 4. Reported distribution of *Schyzocotyle acheilognathi* in Puerto Rico. Map adapted from GBIF-US (2026).

7 Climate Matching

Summary of Climate Matching Analysis

Almost all the contiguous United States had a medium or high climate match for *Schyzocotyle acheilognathi*. The highest matches were concentrated in the Great Lakes, Northeast, Mid-Atlantic, Southwest, Great Basin, and southern California regions. However, high matches extended across much of the Midwest, coastal Southeast, and interior Pacific Northwest as well. The Northern Plains, Colorado Plateau, and interior Southeast had a medium climate match. The only small areas of low climate match were along the Pacific coast from Washington to far northern California and in the Sierra and Cascade Mountain ranges. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.939, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Schyzocotyle acheilognathi* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

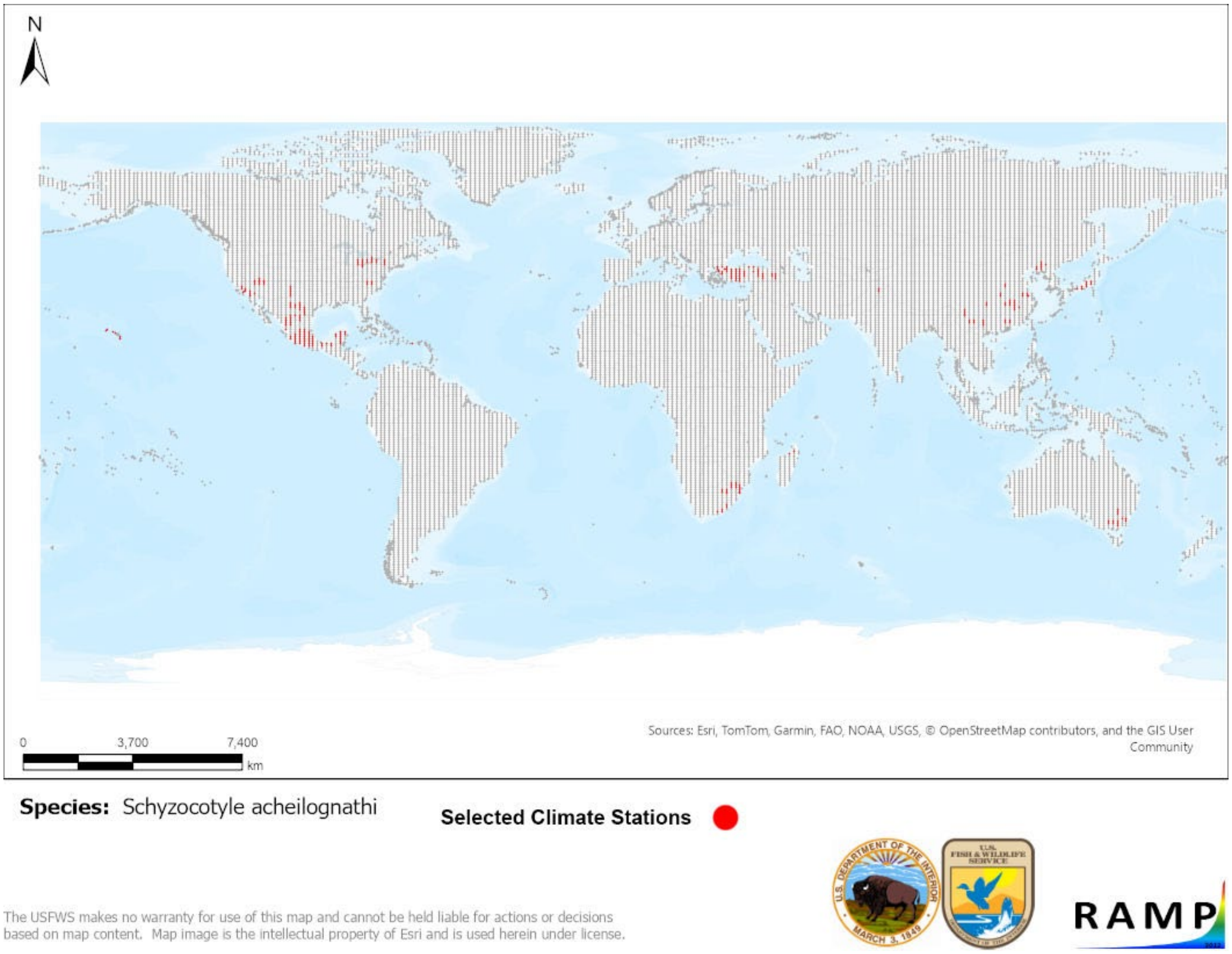

Figure 5. RAMP (Sanders et al. 2023) source map showing global weather stations selected as source locations (red; United States [including Hawaii and Puerto Rico], Canada, Mexico, Turkey, Japan, China, Australia, and South Africa) and non-source locations (gray) for *Schyzocotyle acheilognathi* climate matching. Source locations from Sheikh et al. (2014), Xi et al. (2016), İnnal et al. (2016), Marcogliese et al. (2016), Smit et al. (2017), Scholz et al. (2018), GBIF Secretariat (2023), and Hejna et al. (2026). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

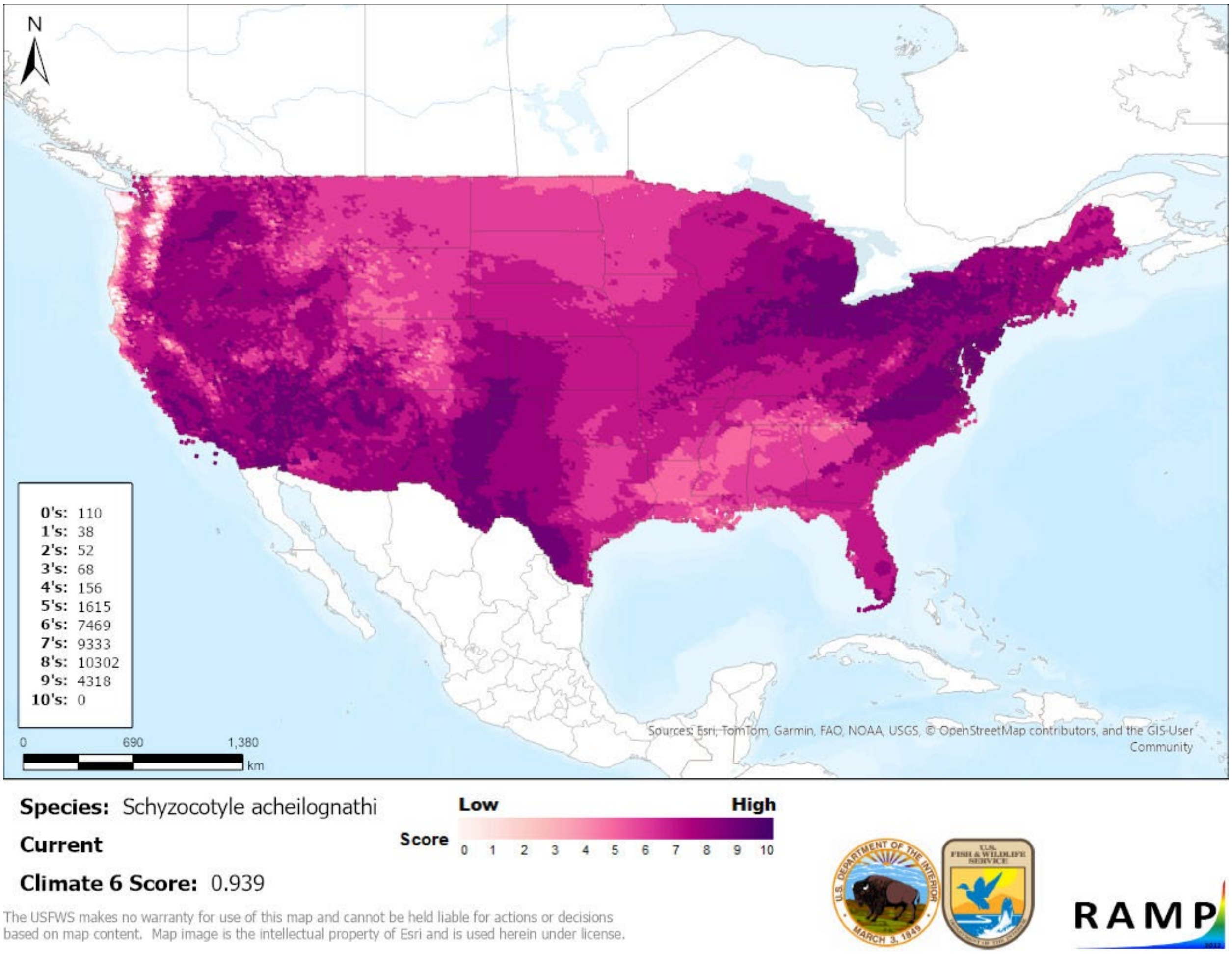

Figure 6. Map of RAMP (Sanders et al. 2023) climate matches for *Schyzocotyle acheilognathi* in the contiguous United States based on source locations reported by Sheikh et al. (2014), Xi et al. (2016), İnnal et al. (2016), Marcogliese et al. (2016), Smit et al. (2017), Scholz et al. (2018), GBIF Secretariat (2023), and Hejna et al. (2026). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Schyzocotyle acheilognathi* is classified as High. There is scientifically credible information that demonstrates the ability of *S. acheilognathi* to establish populations outside its native range, resulting in negative impacts. Although there is incomplete spatial occurrence data on which to base the climate matching analysis, additional occurrence data would not be expected to change the conclusions drawn from the climate matching analysis about risk to the contiguous United States.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Schyzocotyle acheilognathi, the Asian tapeworm, is a fish parasite that is native to eastern Asia. Two of its common host species are the Common Carp (*Cyprinus carpio*) and Grass Carp (*Ctenopharyngodon idella*), both of which have been introduced globally for commercial purposes, which has contributed greatly to its spread. *S. acheilognathi* is extremely host-nonspecific and has been documented in hundreds of other fish species, especially cyprinids. High parasite load of this species is associated with mortality of small fishes in aquaculture settings. In native North American fish species, infection with *S. acheilognathi* has been associated with reduced growth and, particularly under high parasite load, increased mortality. The History of Invasiveness for *Schyzocotyle acheilognathi* is classified as High due to these negative impacts, as well as its wide introduction and establishment in host fishes outside of its native range. The climate matching analysis for the contiguous United States indicates establishment concern for this species. The climate match was high across most of the contiguous United States. The Certainty of Assessment for this ERSS is classified as High due to the substantial scientific evidence documenting nonnative establishment and negative impacts of *S. acheilognathi*. The Overall Risk Assessment Category for *Schyzocotyle acheilognathi* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (see Section 4): High**
- **Establishment Concern (see Section 7): Yes**
- **Certainty of Assessment (see Section 8): High**
- **Remarks, Important additional information: Parasitic organism**
- **Overall Risk Assessment Category: High**

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Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by Sheikh et al. (2014), Xi et al. (2016), İnnal et al. (2016), Marcogliese et al. (2016), Smit et al. (2017), Scholz et al. (2018), GBIF Secretariat (2023), and Hejna et al. (2026).

Under the future climate scenarios (figure A1), on average, high climate match for *Schyzocotyle acheilognathi* was projected to occur in California, the Colorado Plateau, Great Basin, Great Lakes, Mid-Atlantic, Southern Florida, Southern Plains, and Southwest regions of the contiguous United States. On average, areas of scattered low match were found along the northern Pacific coast and a large patch of low to medium-low match covered the inland Southeast region. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.734 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.943 (model: MRI-ESM2-0, SSP3, 2055). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.939, figure 6) falls within the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085, the most extreme climate change scenario. Under one or more time step and climate scenarios, areas within the Colorado Plateau, Northeast, Northern Plains, and Western Mountains saw a moderate increase in the climate match relative to current conditions. Increased climate match occurred primarily at the 2055 time step in the Northeast and primarily at the 2085 time step in regions further west. No large increases were observed regardless of time step and climate scenarios. Under one or more time step and climate scenarios, areas within the Appalachian Range, Mid-Atlantic, Northeast, and Southeast saw a large decrease in the climate match relative to current conditions. Additionally, areas within California, the Great Lakes, Gulf Coast, Southern Atlantic Coast, Southern Plains, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. The areas showing a decrease in climate match expanded in extent under time step 2085, especially under SSP5, as compared to time step 2055. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

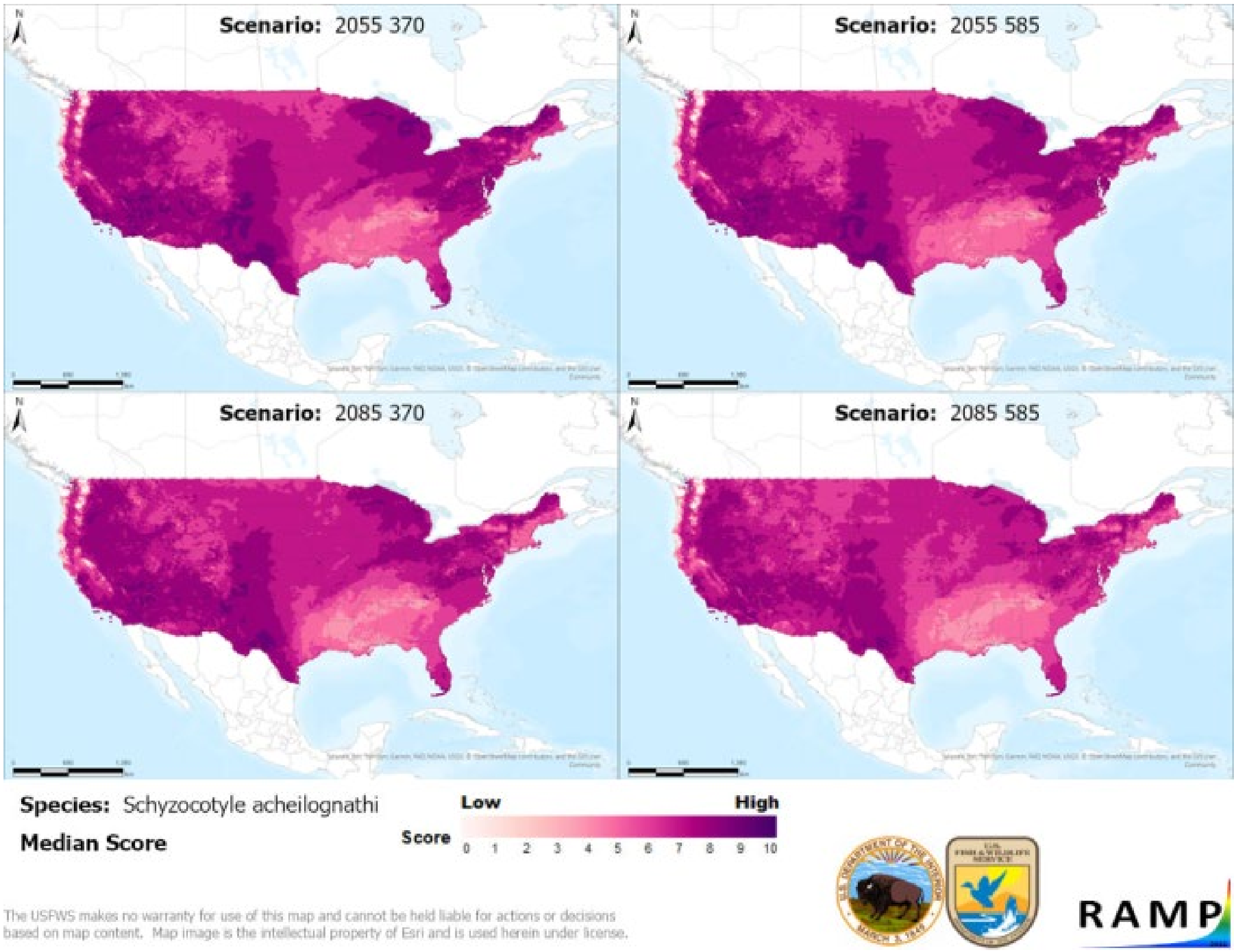

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Schyzocotyle acheilognathi* in the contiguous United States. Climate matching is based on source locations reported by Sheikh et al. (2014), Xi et al. (2016), İnnal et al. (2016), Marcogliese et al. (2016), Smit et al. (2017), Scholz et al. (2018), GBIF Secretariat (2023), and Hejna et al. (2026). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

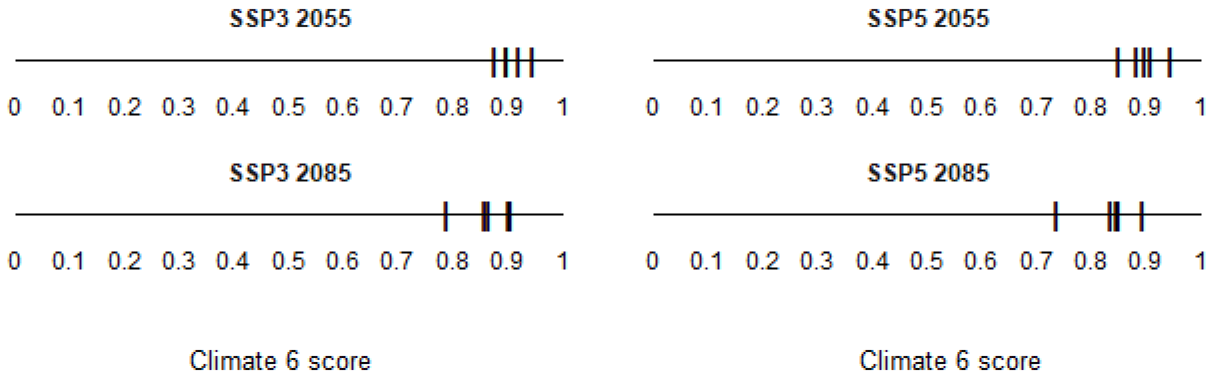

Figure A2. Comparison of projected future Climate 6 scores for *Schyzocotyle acheilognathi* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

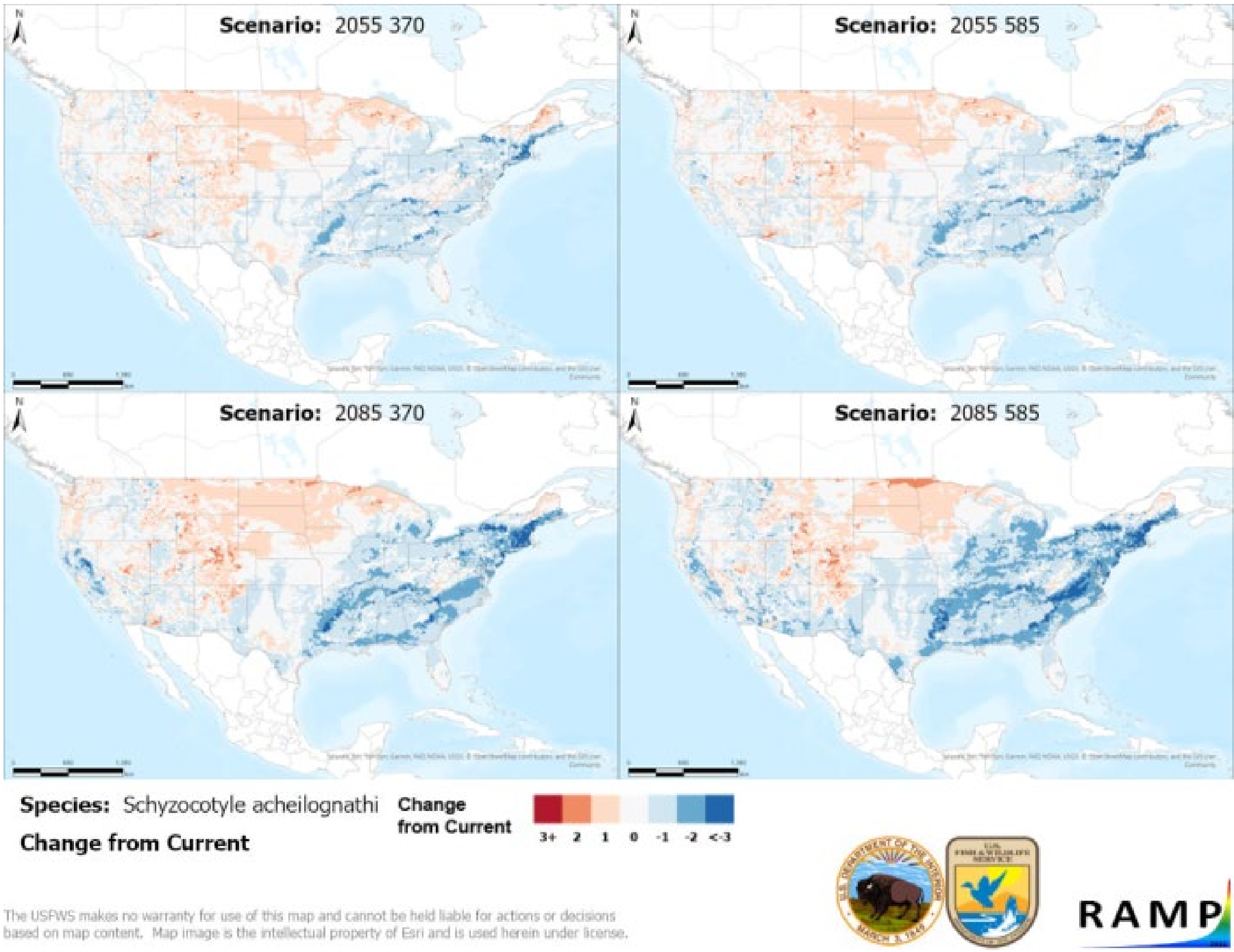

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 6) and the median target point score for future climate scenarios (figure A1) for *Schyzocotyle acheilognathi* based on source locations reported by Sheikh et al. (2014), Xi et al. (2016), İnnal et al. (2016), Marcogliese et al. (2016), Smit et al. (2017), Scholz et al. (2018), GBIF Secretariat (2023), and Hejna et al. (2026). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

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